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Assessing Risk Factors For Diabetes Mellitus Among Pharmacy Students In A Nigerian University: A Cross-Sectional Study

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Abstract:
Background*: The prevalence of diabetes mellitus (DM) is growing not only among the elderly but also among adolescents and teenagers. This study aimed to assess the risk factors for diabetes mellitus among pharmacy students in a Nigerian university.*
Methods*: This study was cross-sectional by design and conducted in the University of Nigeria Nsukka between February 2021 to April 2021. Data were collected with a 21-item structured self-administered questionnaire divided into two domains. The first domain focused on demographic details while the second domain was on anthropometric measurements, blood pressure and random blood sugar tests. Data were analyzed using the IBM SPSS Version 25.0. Descriptive statistics were used to summarize data. Independent t- test and analysis of variance were used for the mean difference analysis between variables, with statistical significance set as $p < 0.05$.*
Results*: Most of the 350 respondents who participated were between 21 to 26 years old (n = 2577, 73.4%), single (n = 333, 95.1%), grew up in urban settings (n = 239, 68.3%) and did not take fruits and vegetables daily (n = 326, 93.1%). Less than half of the respondents had family history of diabetes and hypertension (n = 95, 27.1%). Most of the respondents had normal body mass index, BMI (n = 253, 72.3%), normal waist-hip ratio, WHR (males: n = 172, 99.4%; females: n = 168, 94.9%), normal systolic blood pressure, SBP (n = 345, 98.6%) and normal diastolic blood pressure, DBP (n = 311, 89.9%). A fifth of the respondents were overweight (n = 70, 20.0%) while less than a tenth were obese (n = 18, 5.1%). There was a significant difference in the BMI between the genders (Female Vs. Male: 24.40 Vs. 22.69, t = -4.946, P < 0.001). Married students had a higher WHR than single students who were respondents (0.80 Vs. 0.79, t = -1.257, P < 0.001). There was a significant difference in the SBP between the different age ranges such that those who were above 29 years old had significantly higher SBP than the lower age ranges (F = 4.039, P = 0.003). There was no significant difference in BMI, WHR, SBP and DBP between the different years of study.*
Conclusion: *There was a low risk for diabetes mellitus among the pharmacy students. Students should be encouraged to maintain healthy lifestyle choices that will prevent chronic diseases.*
Key Words*: Diabetes mellitus; Nigeria; Pharmacy; Risk assessment; University*

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I. Introduction

Diabetes Mellitus (DM), a leading cause of death, contributes significantly to the burden of disease[1]. DM has attained a worldwide pandemic status with an increasing prevalence in developing countries, in contrast to some developed countries[2]. The prevalence of diabetes is growing not only among the elderly but also among adolescents and teenagers. Morbidity and mortality in young adults are higher than those in older adults[3].

In Nigeria, the prevalence of diabetes has risen from 2.2% to 5.77% due to identifiable risk factors such as older age, family history, poor diet, residing in urban settings, smoking of cigarettes, sedentary lifestyles, and obesity[4]. Patients with diabetes who have a family history of the disease are at a higher risk category and require more intensive lifestyle modifications and therapeutic interventions, to achieve optimal diabetes control[5].

In developing countries, poor dietary habits and sedentary lifestyles are major contributory factors for the increasing prevalence of diabetes[6]. Nutrition is key in the management of type-2 diabetes (T2D). Food intake may alter and control gene expression and the gut microbiome composition, which is important in the response of cells to insulin. Individuals may respond to treatment by adjusting their dietary patterns[7]. Obesity is an important risk factor for DM, and it results from increasing energy intake, poor physical activity, increased body fat, and elevated free fatty acids, and not merely increased dietary sugars[8]. In obesity, there is increase insulin resistance due to the release of pro-inflammatory chemicals by adipocytes[9]. Abdominal obesity influences insulin secretion and resistance[10]. The activity of immune cells can be altered by obesity. The inflammatory nature of obesity offers new areas of interventions for the treatment of its complications[11]. Physical activity, maintaining a healthy weight and good dietary pattern by reducing the consumption of energy-giving foods and increasing the consumption of fruits, vegetables, nuts, legumes, whole grains, and dairy products are the crucial part of DM management[12]. Furthermore, cigarette smoking increases the risk of diabetes and other health conditions. Smokers have a 30% – 40% higher chance of developing T2D than nonsmokers[13]. Chemicals from tobacco smoke such as nicotine can harm the cells, cause inflammation, reduce insulin sensitivity, and cause oxidative stress by interacting with oxygen in the body. The risk of diabetes can be increased by the cell damage caused by both oxidative stress and inflammation[14].

In 2021, the International Diabetes Federation (IDF) Atlas reported that 1 in 10 youths and adults (537 million), aged 20 years to 79 years, have diabetes. This is 16% higher (74 million) than the estimates made by IDF in 2019. There are still undiagnosed adults (447%), despite the global prevalence of the disease being placed at 10.5%[15].

The academic requirements of students in the medical-related fields could lead to sedentary lifestyles. Although some studies have established the commonality of overweight and obese pharmacy students, university students, and young adults in Nigeria, the university population has been understudied with respect to the risk for metabolic dysfunctions such as DM[16-19]. Despite the fact that the pharmacy curriculum comprises fundamental medical and health science courses to increase students' knowledge of DM, this may be contrary in practice. Little is known about pharmacy students' risk for T2D. Data gathered from this study will aid in the determination of specific risk factors that are most prevalent among Nigerian pharmacy students. With the findings of this study, health educators could develop preventive measures or interventions that can be tailored specifically to pharmacy students, and university students at large. The main objective of this study was to assess the risk factors for diabetes mellitus among pharmacy students in a first-generation federal university in Nigeria.

II. Methods

This study was conducted among undergraduate pharmacy students in the Faculty of Pharmaceutical Sciences, University of Nigeria, Nsukka (February 2021 to April 2021).

Study Design: Cross-sectional.

Study Location: Faculty of Pharmaceutical Sciences, University of Nigeria, Nsukka (UNN).

Study Duration: February 2021 to April 2021.

Sample Size: Three hundred and fifty students (350) students were targeted.

Sample Size Calculation: As of the time the study was conducted, the total number of pharmacy students from the second year to the fifth year was 1566. Raosoft® Sample Size Calculator was used to calculate the sample size. At a 5% margin of error, 95% confidence interval, and assuming 50% response distribution, the recommended minimum sample size was 309. To consider the return of incomplete questionnaires, the sample size was increased to 350.

Ethical Clearance: Ethical clearance to conduct the study was received from the Health Research Ethics Committee (HREC) of University of Nigeria Teaching Hospital (UNTH), Ituku-Ozalla on 4th December, 2020 (UNTH/CSA/329/VOL.5). There was voluntary participation. Participants were informed that they could withdraw from the study, irrespective of previous consent.

Eligibility Criteria: As of the time the study was conducted, the Faculty was running a 5-year B.Pharm programme with the professional years commencing from the second year. Second to final-year pharmacy students in the university who provided consent for participation were included. First-year pharmacy students were excluded.

Data Collection: The study instrument was a 21-item questionnaire in two domains. The questionnaire was self-administered. The first domain comprised demographic details and questions from the type 2 diabetes online diabetes risk assessment developed by the International Diabetes Federation[20]. The second domain comprised the anthropometric measurements, blood pressure (BP), and random blood sugar (RBS) test.

Standard equipment were used for the anthropometric measurements. A portable meter rule was used to measure heigh to the nearest 0.5 cm. A calibrated standard electronic weighing scale was used to check weight to the nearest 0.1 Kg. The World Health Organization (WHO) recommendations to define underweight, normal weight, healthy weight, and obese individuals were used to classify Body Mass Index (BMI). BMI was calculated as weight (Kg) divided by the square of height (m^2). A flexible non-stretchable tape was used to measure the waist circumference (WC) at the level of the umbilicus, and the hip circumference, at the widest girth of the hip. To calculate the waist-hip ratio (WHR), the waist circumference (WC) was divided by the hip circumference (HC).

A standard mercury sphygmomanometer was used to measure blood pressure (BP) on the left arm of the students, in an upright sitting position. This was after the students had rested for at least five minutes. Measurements were taken twice, and the average was used. The Joint National Committee (JNC 8) guidelines was used to classify the blood pressure readings. Accu-Chek Active® blood glucose monitoring device was used to measure Random Blood Sugar (RBS).

Clinical Pharmacists of the Department of Clinical Pharmacy and Pharmacy Management at the university validated the content of the questionnaire. A pilot study was carried out using six students from the eligible classes. Results from the pilot study were excluded from the main study. The content validity and pilot test eliminated all ambiguities and irrelevances, as well as provided an estimated time for filling out the questionnaire and taking the measurements.

Data analysis: IBM SPSS Version 25.0 (IBM Corp, Version 25.0, Armonk, NY, USA) was used for data analysis. Data were summarized with descriptive statistics. Independent t-test and analysis of variance (ANOVA) were used for the mean difference analysis. with statistical significance set as $p < 0.05$.

III. Results

There were 1566 students (from the second year to the fifth year) in the Faculty of Pharmaceutical Sciences of the university. This comprised second-year students (470), third-year students (413), fourth-year students (347), and fifth-year students (336).

Three hundred and fifty (350) students were sampled by convenience, taking into consideration the sizes of the different classes. Thus, these students were conveniently sampled from the different classes: second year (105), third year (92), fourth year (78), and fifth year (75).

The respondents were majorly 21 to 26 years old (n = 257, 73.4%), single (n = 333, 95.1%), grew up in urban settings (n = 239, 68.3%) and did not take fruits and vegetables daily (n = 326, 93.1%). A family history of hypertension (n = 104, 29.7%), and diabetes (n = 95, 27.1%), was reported by less than half of the respondents. See Table 1.

Table 1: Demographic details, N = 350

Variables	n (%)
Age (in years)	
<18	0 (0.00)
18 – 20	64 (18.3)
21 – 23	161 (46.0)
24 – 26	96 (27.4)
27 – 29	24 (6.9)
>29	5 (1.4)
Gender	
Male	173 (49.4)
Female	177 (50.6)
Year of study	
2nd	105 (30.0)
3rd	91 (26.0)
4th	79 (22.6)
5th	75 (21.4)
Marital status	
Single	333 (95.1)
Married	17 (4.9)
Place of upbringing	
Urban	239 (68.3)
Rural	111 (31.7)
Engagement in at least 30 minutes of daily physical activity	198 (56.6)
Frequency of fruits and vegetables intake	

Everyday	24 (6.9)
Not everyday	326 (93.1)
Ever taken medication for high blood pressure	16 (4.6)
Ever found to have high blood glucose	21 (6.0)
Family history of hypertension	104 (29.7)
Family history of diabetes	95 (27.1)
Smoked at least one stick of cigarette in the last 30 days	
Yes	18 (5.1)
No	117 (33.4)
I do not smoke at all	215 (61.4)

Table 2 shows that the mean BMI for the respondents was 23.56 ± 3.35 (Kg/m^2). The mean waist-hip ratio was 0.79 ± 0.05. The mean systolic blood pressure and diastolic blood pressure were 113.27 ± 10.13 (mmHg) and 73.69 ± 9.69 (mmHg), respectively.

Table 2: Anthropometric measurements, blood pressure measurement and random blood sugar test, N = 350

Variables	**Mean ± SD**
Height (m)	1.71 ± 0.08
Weight (Kg)	68.69 ± 9.94
BMI (Kg/m^2)	23.56 ± 3.35
WC (cm)	79.50 ± 6.91
HC (cm)	101.17 ± 7.27
WHR	0.79 ± 0.05
SBP (mmHg)	113.27 ± 10.13
DBP (mmHg)	73.69 ± 9.69
RBS (mg/dL)	95.17 ±15.63

BMI = Body Mass Index; WC = Waist Circumference; HC = Hip Circumference; WHR = Waist-Hip Ratio; SBP = Systolic Blood Pressure; DBP = Diastolic Blood Pressure; RBS = Random Blood Sugar

Table 3 shows that most of the respondents had normal BMI (n = 253, 72.3%), normal WHR (males: n = 172, 99.4%; females: n = 168, 94.9%), normal SBP (n = 345, 98.6%) and normal DBP (n = 311, 89.9%). A fifth of the respondents were overweight (n = 70, 20.0%) while less than a tenth were obese (n = 18, 5.1%).

Table 3: Classification of body mass index, waist-hip ratio, systolic blood pressure and diastolic blood pressure, N = 350

Variables	**n (%)**
BMI (Kg/m^2)	
Underweight (≤ 18.49)	9 (2.6)
Normal (18.5 – 24.99)	253 (72.3)
Overweight (25.00 – 29.99)	70 (20.0)
Obese (≥ 30)	18 (5.1)
WHR (Females)	
Normal (≤ 0.85)	168 (94.9)
High (> 0.85)	9 (5.1)
WHR (Males)	
Normal (≤ 0.90)	172 (99.4)
High (> 0.90)	1 (0.6)
SBP (mmHg)	
Normal (<140)	345 (98.6)
High (≥140)	5 (1.4)
DBP (mmHg)	
Normal (<90)	311 (89.9)
High (≥ 90)	39 (11.1)

The mean BMI was higher in females compared to the male respondents (24.40 Vs. 22.69, t = -4.946, P < 0.001). In addition, married students had higher mean BMI than single students (25.81 Vs. 23.44, t = -2.881, P = 0.004). Males had a higher mean WHR (0.80 Vs. 0.77, t = 5.995, P < 0.001) and mean DBP (74.84 Vs. 72.58, t = 2.196, P = 0.029) than females. Respondents who claimed to regularly engage in daily physical activity had a higher mean WHR than those who reported that they did not engage in daily physical activity (0.79 Vs. 0.78, t = 2.933, P = 0.004). See Table 4.

Table 4: Mean difference analysis (Independent samples t-test), N = 350

Variables	BMI				WHR				SBP				DBP			
	Mean	**SD**	**t**	**P**	**Mean**	**SD**	**t**	**P**	**Mean**	**SD**	**t**	**P**	**Mean**	**SD**	**t**	**P**
Gender			-4.946	<0.001**			5.995	<0.001**			0.976	0.330			2.196	0.029*
Male	22.69	2.61			0.80	0.04			113.81	10.34			74.84	10.01		
Female	24.40	3.75			0.77	0.50			112.75	9.93			72.58	9.25		
Marital status			-2.881	0.004*			-1.257	0.210			-1.756	0.080			-1.109	0.268
Single	23.44	3.30			0.79	0.04			113.06	9.90			73.56	9.74		
Married	25.81	3.56			0.80	0.09			117.47	13.70			76.24	8.36		
Place of upbringing			0.283	0.778			-1.823	0.069			-0.581	0.575			-0.047	0.963
Urban	23.59	3.54			0.78	0.05			113.07	10.50			73.68	9.50		
Rural	23.48	2.90			0.79	0.05			113.72	9.33			73.63	10.12		
A6			-0.821	0.412			2.933	0.004*			0.379	0.705			0.562	0.574
Yes	23.43	2.94			0.79	0.05			113.45	9.63			73.95	9.71		
No	23.73	3.81			0.78	0.04			113.04	10.78			73.36	9.68		
A7			0.377	0.707			0.040	0.968			0.217	0.828			-0.320	0.749
Everyday	23.81	3.71			0.79	0.05			113.71	10.86			73.08	9.49		
Not everyday	23.54	3.32			0.79	0.05			113.24	10.10			73.74	9.71		
A8			0.649	0.517			1.041	0.299			1.942	0.053			-0.003	0.998
Yes	24.09	3.20			0.80	0.05			118.06	13.67			73.69	9.63		
No	23.53	3.36			0.79	0.05			113.04	9.90			73.69	9.70		
A9			-1.478	0.140			0.725	0.469			-1.262	0.208			-0.292	0.771
Yes	22.51	2.75			0.79	0.04			110.57	11.18			73.10	8.16		
No	23.62	3.37			0.79	0.05			113.45	10.06			73.73	8.79		

A10			0.483	0.629			-0.845	0.398			1.299	0.195			0.721	0.471
Yes	23.69	3.33			0.78	0.05			114.36	10.12			74.27	9.56		
No	23.50	3.36			0.79	0.04			112.82	10.13			73.45	9.75		
A11			1.198	0.232			-0.588	0.557			0.592	0.554			1.455	0.147
Yes	23.91	3.41			0.78	0.05			113.80	8.73			74.93	9.63		
No	23.43	3.32			0.79	0.04			113.08	10.62			73.24	9.69		

*p < 0.05; **p < 0.001; SD = Standard deviation; BMI = Body Mass Index; WHR =Waist-to-Hip Ratio; SBP = Systolic Blood Pressure; DBP = Diastolic Blood Pressure; A6 = Do you usually do at least 30 minutes of daily physical activity?; A7 = How often do you eat fruits and vegetables?; A8 = Have you ever taken medication for high blood pressure?; A9 = Have you ever been found to have high blood glucose?; A10 = Do you have a family history of hypertension?; A11 = Do you have a family history diabetes?

The different age ranges had statistically significant differences in the systolic blood pressure, SBP (F = 4.039, P = 0.003). Those who were above 29 years old had significantly higher SBP than respondents who were younger, Table 5. The BMI, WHR, SBP, and DBP, showed to significant difference between the different years of study.

Table 5: Mean difference analysis (Analysis of variance, ANOVA), N = 350

Variables	**BMI**					**WHR**					**SBP**					**DBP**				
	n	**Mean**	**SD**	**95% CI**	**P**	**n**	**Mean**	**SD**	**95% CI**	**P**	**n**	**Mean**	**SD**	**95% CI**	**P**	**n**	**Mean**	**SD**	**95% CI**	**P**
Age (in years)					0.363					0.123					0.003*					0.314
< 18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18 – 20	64	23.28	3.83	22.32 - 24.23		64	0.79	0.05	0.78–0.80		64	109.97	10.61	107.32 - 112.62		64	72.06	9.99	69.57 - 74.56	
21 – 23	161	23.68	3.33	23.16 - 24.20		161	0.78	0.04	0.77 – 0.79		161	112.88	9.18	111.45 - 114.30		161	73.75	9.99	72.19 - 75.30	
24 – 26	96	23.41	3.00	22.81 - 24.02		96	0.79	0.04	0.78 – 0.80		96	115.70	9.95	113.68 - 117.71		96	74.61	9.21	72.75 - 76.47	
27 – 29	24	23.45	3.11	20.80 - 31.89		24	0.80	0.05	0.77 – 0.82		24	113.42	11.31	108.64 - 118.91		24	72.79	8.71	69.11 - 76.47	
>29	5	26.34	4.46	23.21 - 23.91		5	0.82	0.07	0.73 – 0.92		5	121.20	18.09	98.74 - 143.66		5	79.60	7.80	69.92 - 89.28	

*p < 0.05; **p < 0.001

SD = Standard Deviation; CI = Confidence Interval; BMI = Body Mass Index; WHR =Waist-to-Hip Ratio; SBP = Systolic Blood Pressure; DBP = Diastolic Blood Pressure

IV. Discussion

The majority of the respondents were aged 21 to 26 years old, single, grew up in urban settings, and did not take fruits and vegetables daily. The Centers for Disease Control and Prevention (CDC), reported that the

prevalence of prediabetes among adolescents aged 12 – 18 years, and young adults aged 19 – 34 years, is at nearly 20% and 25%, respectively[21].

There are different reports on the risk of developing diabetes based on the area of settlement, whether rural or urban settings, with the majority reporting an increased prevalence of diabetes among urban dwellers[22–24], while others showed negligible difference or higher prevalence rate of diabetes among rural dwellers[25, 26].

The majority of the respondents reported poor daily intake of fruits and vegetables. This is similar to the findings of a study conducted in Northern India where a large proportion of college students had inadequate intake of fruits and vegetables[27]. There are beneficial phytochemicals in fruits and vegetables that can protect against diabetes and cardiovascular disease, and their consumptions provides the necessary micronutients[28,29]. In developing countries, both the knowledge and intake of fruits and vegetables are poor[30]. Healthy food consumption, with high fruit intake, is essential in the prevention of T2D[31].

Less than half of the students who participated in the study had a family history of hypertension and diabetes. A study reported a high prevalence of hypertension (55.9%) and diabetes (23.3%) in Nigeria[32]. Similarly, a high prevalence of hypertension has been documented for persons with DM (54.2%).[33] Certain health conditions such as diabetes, cancer, stroke, and heart disease, are strongly-linked to family history. With sufficient knowledge of family history, the risk of developing some diseases, can be reduced[34].

BMI, WHR, SBP, and DBP were all within normal range and most of the respondents had normal values. In contrast, findings from another study reported an overall prevalence of obesity among youths, with the majority being females[35]. SBD and DBP have been documented to increase with higher BMI. Weight loss has been reported to reduce blood pressure, significantly[36].

A fifth of the respondents were overweight while less than a tenth were obese. Obesity has been documented as a highly-relevant modifiable risk factor for T2D[37]. It does not only increase the risk for metabolic and cardiovascular diseases but other health conditions such as arthritis, respiratory disorders, depression, some cancers[37]. Persons with BMI > 25 Kg/m^2 are at significantly higher risk of having T2D[38]. Studies have revealed that the risk for T2D is higher in severely obese individuals (BMI ≥ 40 Kg/m^2) than those with a lower BMI (BMI 30 – 39.9 Kg/m^2) [39].

Female and married respondents had a higher mean BMI than male and single respondents. The percent body fat is higher in women than in men while men have a relatively more central fat distribution[37,40]. These differences, caused by the sex hormones, are highly-evident in puberty[41].

Males had a higher mean WHR and mean DBP than females. This is similar to a study conducted on a group of medical students in the Slovak Republic where males had higher SBP, DBP, and BMI but higher body fat percentages compared to females[42]. Cardiovascular diseases and T2D are associated with higher SBP or DBP[43,44].

Respondents who claimed to regularly engage in daily physical activity had a higher mean WHR than those who reported that they did not engage in daily physical activity. The reason for this could be that such persons with high WHR may have been concerned about health-related risks or merely about physical fitness. Weight loss, healthy diet, and aerobic exercise several times a week can reduce the risk of high WHR[45].

The limitations of the study include the utilization of a single university in Nigeria and with a particular set of students (cross-sectional design). The findings should not be applied to other settings, without caution. Convenience sampling of the respondents was employed due to the failure in attempts to obtain the gender distribution data of the students which would have aided a probability sampling technique. Thus, we assumed an equal distribution of male and female students in each class. Furthermore, there was low response and compliance with the anthropometric measurements. This was partly influenced by the rush and academic work overload, as students were just resuming after the coronavirus disease (COVID-19) lockdown. In addition, students, particularly females, were uncomfortable with needle pricks for sugar tests and taking measurements of their weight and body mass index.

V. Conclusion

There was a low risk for diabetes mellitus (DM) among the pharmacy students. Students should be encouraged to maintain healthy lifestyle choices that will prevent chronic diseases.

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